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Datasheet for the decision of 7 June 2019

Case Number: T 1830/14 - 3.4.03

Application Number: 05851466.2

Publication Number: 1834515

IPC: H05K7/20

Language of the proceedings: EN

Title of invention:
COOLING APPARATUS, SYSTEM, AND ASSOCIATED METHOD

Patent Proprietor:
The Boeing Company

Opponent:
AIRBUS (SAS) (FR)/AIRBUS Opérations(FR)
AIRBUS Operations Limited(GB)/Airbus Operations GmbH(DE)AIRBUS Operations S.L (ES)

Headword:

Relevant legal provisions:
EPC Art. 123(3)
EPC 1973 Art. 56

Keyword:
Amendments - broadening of claim - main request, auxiliary requests 1- 3 (yes)
Inventive step - auxiliary request 4 (yes)

Decisions cited:
G 0002/88, T 0082/93

Catchword:

Europäisches Patentamt
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Beschwerdekammern

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Case Number: T 1830/14 - 3.4.03

D E C I S I O N
of Technical Board of Appeal 3.4.03
of 7 June 2019

Appellant: (Patent Proprietor)	The Boeing Company 100 North Riverside Plaza Chicago, IL 60606-1596 (US)
Representative:	Witte, Weller & Partner Patentanwälte mbB Postfach 10 54 62 70047 Stuttgart (DE)
Respondent: (Opponent)	AIRBUS (SAS) (FR)/AIRBUS Opérations(FR) AIRBUS Operations Limited(GB)/Airbus Operations GmbH(DE)AIRBUS Operations S.L (ES) 1 Rond-Point Maurice Bellonte/ 316, route de Bayonne/Kreetslag 10/New Filton House, Filton/ Avenida de John Lennon S/N FR-31700 Blagnac/FR-31060 Toulouse/DE-21129 Hamburg/GB-Bristol BS99 7AR/ES-Madrid (FR)
Representative:	Santarelli 49, avenue des Champs-Elysées 75008 Paris (FR)
Decision under appeal:	**Decision of the Opposition Division of the European Patent Office posted on 17 July 2014 revoking European patent No. 1834515 pursuant to Article 101(3)(b) EPC.**

Composition of the Board:

Chairman	G. Eliasson
Members:	M. Papastefanou
	G. Decker

Summary of Facts and Submissions

I. The appeal is against the decision of the opposition division revoking European patent No. 1 834 515 B1.

II. The opposition was based on the grounds under Article 100(a) EPC (lack of novelty and inventive step) and 100(c) EPC (added subject-matter).

In the decision under appeal, the opposition division came to the conclusion that the subject-matter of claim 1 of the Main Request before it (patent as granted) did not involve an inventive step. Claim 1 of Auxiliary Requests 1 and 2 contained added subject-matter, claim 1 of Auxiliary Requests 3 and 4 did not involve an inventive step and claim 1 of Auxiliary Request 5 was not clear and contained added-subject matter.

III. In the decision under appeal reference was made, among others, to the following documents:

E1: US 2004/0120116 A1;
E2: US 5,283,715;
E3: US 2003/0037910 A1; and
E5: US 2004/0037045 A1.

IV. The appellant - patent proprietor (hereafter "appellant") requested initially that the decision under appeal be set aside and that the patent be maintained on the basis of the Main Request or one of Auxiliary Requests 1 to 7, all filed with the statement of the grounds of appeal.

After the board summoned to oral proceedings and issued its preliminary opinion, the appellant submitted

amended requests.

V. The respondents - opponents did not reply to the appeal. They have not made any substantive submissions or requests, either.

VI. At the end of the oral proceedings before the board, which the respondents did not attend as they had announced in advance, the final requests of the appellant were to set the decision under appeal aside and maintain the patent according to the Main request or one of the Auxiliary Requests 1 to 8, all filed with the appellant's letter dated 6 May 2019.

VII. Auxiliary Request 4 consists of the following documents:

- Claims 1 to 7 according to Auxiliary Request 4 filed with the letter dated 6 May 2019;
- Description: Pages 2, 3, 6 and 7 filed at the oral proceedings before the board dated 7 June 2019 and pages 4 and 5 of the patent specification;
- Drawings: Figures 1 to 11 of the patent specification.

VIII. Claim 1 of the **Main Request** is worded as follows:

A cooling apparatus (10) comprising:

a chassis housing (13);

at least one printed circuit board (12) having opposed major surfaces and positioned within the chassis housing (13);

at least one heat source (18) positioned on one major

surface of the printed circuit board (12);

a pulsating heat pipe (14) having at least a portion that is positioned to either extend along and proximate to one of the major surfaces or be embedded within the printed circuit board (12), wherein the pulsating heat pipe (14) is capable of transferring heat from the printed circuit board (12); and

a loop heat pipe (16) thermally coupled to the pulsating heat pipe (14), the loop heat pipe (16) comprising an evaporator (24) and a condenser (26),

wherein the pulsating heat pipe (14) comprises an evaporator (20) and a condenser (22), and wherein the evaporator (24) of the loop heat pipe (16) is thermally coupled to the condenser (22) of the pulsating heat pipe (14); and

wherein the condenser (22) of the pulsating heat pipe (14) is positioned within a wall of the chassis housing (13).

IX. Compared to claim 1 of the Main Request, claim 1 of **Auxiliary Request 1** has the additional feature at the end:
"such that the condenser (22) of the pulsating heat pipe (14) does not take up any space within an interior of the chassis housing (13)."

X. Compared to claim 1 of the Main Request, claim 1 of **Auxiliary Request 2** has the additional feature at the end:
"between a first surface and a second surface of the same wall".

XI. Compared to claim 1 of the Main Request, claim 1 of **Auxiliary Request 3** has the additional features at the end:
"*such that the condenser (22) of the pulsating heat pipe (14) does not take up any space within an interior of the chassis housing (13),*

wherein the loop heat pipe (16) is positioned adjacent to an outer surface of the pulsating heat pipe (14), such that the loop heat pipe (16) is thermally coupled to the pulsating heat pipe (14)."

XII. Claim 1 of **Auxiliary Request 4** is worded as follows:

A cooling apparatus (10) comprising:

a chassis housing (13);

at least one printed circuit board (12) having opposed major surfaces and positioned within the chassis housing (13);

at least one heat source (18) positioned on one major surface of the printed circuit board (12); and

a pulsating heat pipe (14) having at least one portion positioned to either extend along and proximate to one of the major surfaces or be embedded within the printed circuit board (12), wherein opposing ends of the pulsating heat pipe (14) are coupled to the chassis housing (13), and wherein the pulsating heat pipe (14) is capable of transferring heat from the printed circuit board (12),

and a loop heat pipe (16) thermally coupled to the

pulsating heat pipe (14), the loop heat pipe (16) comprising an evaporator (24) and a condenser (26), wherein a condenser (22) of the pulsating heat pipe (14) is positioned within a wall of the chassis housing (13).

Independent claim 5 of **Auxiliary Request 4** is worded as follows:

A method for cooling at least one printed circuit board (12), the method comprising:

providing a cooling system (10) comprising:

- *a chassis housing (13);*
- *at least one printed circuit board (12) having opposed major surfaces and positioned within the chassis housing (13);*
- *at least one heat source (18) positioned on one major surface of the printed circuit board (12); and*
- *a pulsating heat pipe (14) having at least one portion positioned to either extend along and proximate to one of the major surfaces or be embedded within the printed circuit board (12);*
- *positioning a condenser (22) of the pulsating heat pipe (14) within a wall of the chassis housing (13);*
- *thermally coupling a loop heat pipe (16) to the pulsating heat pipe (14), the loop heat pipe (16) comprising an evaporator (24) and a condenser*

(26);

transferring heat from the printed circuit board (12) with the pulsating heat pipe (14); and

transferring heat away from the printed circuit board (12) and out of the chassis housing (13) by movement of the heat through the pulsating heat pipe (14).

XIII. The wording of the claims of the remaining requests is not relevant for this decision.

XIV. The appellant's arguments could be summarised as follows:

With respect to the extension of protection (Article 123(3) EPC) the appellant argued essentially that a cooling system without the deleted feature (*"wherein opposing ends of the pulsating heat pipe (14) are coupled to the chassis housing (13)"*) was defined in independent claim 9 as granted, which defined in practice a method of operating the cooling apparatus. The scope of protection was defined by the claims as a whole and since the apparatus was defined within the operating method claim, a claim for a cooling system with the features as in the method claim was not extending the scope of protection. Moreover, making reference to the Guidelines for Examination, the appellant argued that the amendment could be regarded as a change of claim category, from a method claim to an apparatus claim, which was allowed under certain circumstances that applied also at the present case.

With respect to inventive step, the appellant argued essentially that the apparatus of E5 had a different structure from the apparatus of the invention and the

skilled person would not be in a position to modify it and arrive at the claimed invention in an obvious way.

Reasons for the Decision

1. The invention

1.1 The invention relates to a cooling apparatus for cooling printed circuit board(s) and the corresponding method. The main idea of the claimed invention is to provide a combination of heat pipes to transfer heat generated during the operation of electronic components (heat sources) that are placed on a printed circuit board (PCB) away from the PCB. Printed circuits boards are placed inside a chassis housing (see Figure 3 for example). A first heat pipe, which is a pulsating heat pipe (PHP) comprising an evaporator and a condenser, is positioned adjacent to or embedded into the PCB, inside the chassis housing, in order to transfer heat away from the PCB. A second pipe, which is a loop heat pipe (LHP) comprising also an evaporator and a condenser, is thermally coupled to the PHP and is adapted to transfer heat away from the PHP. With this two-stage transfer of heat away from the PCB, an improved overheat protection of the PCB and the components installed on/in it is achieved.

1.2 A feature of the invention that is considered important is the positioning of the condenser of the pulsating heat pipe (PHP) within a wall of the chassis housing in an effort to save space (see condenser 22 in Figure 3).

2. Main Request

2.1 Compared to the cooling apparatus defined in claim 1 as granted, in the apparatus claim 1 of the Main Request

the feature *"wherein opposing ends of the pulsating heat pipe (14) are coupled to the chassis housing (13)"* (see lines 12 and 13 in column 13 of the patent specification) has been deleted.

Despite the fact that there are additional features of the cooling apparatus in claim 1 of the Main Request when compared to granted claim 1 (such as a loop heat pipe), the deletion of the above-mentioned feature caused an extension of the claimed scope of protection, since apparatuses without the deleted feature would now fall within the claimed scope although they did not fall within the scope of protection of the granted claims. This extension of protection is also confirmed by the fact that the cooling apparatus according to claim 1 of the Main Request (i.e. after the amendment) is outside the scope of granted claim 1 (i.e. before the amendment), since it does not comprise the deleted feature (see G 2/88, OJ EPO 1990, 93, point 4.1 of the reasons).

2.2 The appellant argued that the scope of protection should be defined by the claims as a whole and compliance with Article 123(3) EPC should be assessed by comparing the whole scope of protection after the amendment with the scope of protection of the granted patent claims as a whole and not by comparing the scopes of individual claims.

The appellant pointed to the granted (independent) method claim 9, which defined a method for cooling at least one printed circuit board. According to the appellant, this claim defined a cooling apparatus without the deleted feature and, therefore, deleting this feature from the apparatus claim did not broaden the scope of protection.

The appellant argued further that claim 1 of the Main Request was to be regarded as a conversion of the granted method claim 9 to an apparatus claim. The appellant referred to a passage of the Guidelines for Examination at the EPO according to which *"...it may exceptionally be allowable to replace a claim directed to a method of operating a device by a claim directed to the device itself if the original claim contains the claimed features of the device exhaustively, whether in structural or functional terms (see T 378/86 and T 426/89)"* (see Guidelines for Examination at the EPO, November 2018, Part H V.7.3). Granted claim 9 defined a method of operation of the cooling apparatus and defined exhaustively all the structural features of the cooling apparatus; hence, a conversion of a method claim to an apparatus claim was not infringing Article 123(3) EPC (see the statement of grounds of appeal, paragraph bridging pages 10 and 11 and appellant's letter dated 6 May 2019, pages 3 and 4).

2.3 The board agrees with the appellant that the scope of protection mentioned in Article 123(3) EPC refers to the scope defined by the patent claims as a whole. In practice, this scope of protection is determined by the claim which defines the broadest scope of protection. It is generally established that a claim directed to an apparatus provides absolute protection of the defined apparatus and, hence, its scope of protection is broader than the scope defined by a claim directed to a method of production or use of the same apparatus.

2.3.1 The appellant pointed out that in the opposed patent, claim 9 was directed to a method for cooling at least one PCB, which was to be understood as a method for operating the cooling apparatus.

The board agrees. Referring back to the Guidelines for Examination, the board notes that the sentence following the passage cited by the appellant reads as follows: *"This exception, however, does not apply if the device as now claimed is for its features no longer dependent on the circumstances of its operation whereas it depended on them under the terms of the prior method claim (see T 82/93)"* (ibid.).

Decision T 82/93 offers a more detailed explanation:

"Thus in general terms, if a patent as granted only includes claims defining the operation of a device and therefore containing both 'device features' and 'method features', and the patent as proposed to be amended during opposition proceedings includes claims which only contain 'device features', the proposed amendment is not allowable having regard to Article 123(3) EPC, because the patent as granted confers protection upon the device only when it is in use so as to carry out the method, whereas the patent as proposed to be amended would confer protection upon the device whether or not it is in use, and would therefore confer additional protection compared to the patent as granted." (T 82/93, OJ EPO 1996, 274, point 2.5 of the reasons).

2.3.2 In the present case, claim 9 as granted comprises features defining the cooling apparatus as the appellant pointed out ("device features") but it also comprises features defining its operation ("method features"), more specifically:

- *transferring heat from the printed circuit board (12) with the pulsating heat pipe (14); and*

- *transferring heat away from the printed circuit board (12) and out of the chassis housing (13) by movement of the heat through the pulsating heat pipe (14).*

2.3.3 The board is thus of the opinion that the protection conferred by granted claim 9 to the defined cooling apparatus is limited only to the apparatus when it is transferring heat according to the two features cited above, i.e. only when it is in operation.

Claim 1 according to the Main Request defines the same cooling apparatus as granted claim 9, but confers absolute protection to it, irrespectively of whether it is in operation or not. Hence, its scope of protection is broader than that of granted claim 9.

2.3.4 The board concludes, therefore, that the Main Request does not fulfil the requirements of Article 123(3) EPC.

3. Auxiliary Requests 1 to 3

3.1 In the apparatus according to claim 1 of Auxiliary Requests 1, 2 and 3, the feature *"wherein opposing ends of the pulsating heat pipe (14) are coupled to the chassis housing (13)"* is missing, like in claim 1 of the Main Request.

3.2 The board concludes, therefore, that none of the Auxiliary Requests 1, 2 and 3 fulfills the requirements of Article 123(3) EPC for the same reasons as the Main Request.

4. Auxiliary Request 4

Auxiliary Request 4 corresponds to Auxiliary Request 3

underlying the impugned decision, with some minor wording amendments.

4.1 Amendments (Articles 123(2), 123(3) EPC and 84 EPC 1973).

4.1.1 The cooling apparatus according to claim 1 of Auxiliary Request 4 comprises the feature missing from the previous requests and fulfils, therefore, the requirements of Article 123(3) EPC.

4.1.2 In the decision under appeal, the opposition division concluded that the request fulfilled the requirements of Article 123(2) EPC (points 9.2 to 9.6 of the reasons) and the opponent has not contested this. The board agrees with the finding of the opposition division (see also point 2 of the statement of the grounds of appeal).

4.1.3 The wording amendment carried out in claim 6 addresses the objection under Article 84 EPC 1973 raised in the board's preliminary opinion (see point 7.2 of the board's communication of 12 November 2018).

4.1.4 The amendments to the description consist in adapting it to the claims of Auxiliary Request 4 and citing document E5.

4.1.5 The board is, thus, satisfied that Auxiliary Request 4 fulfills the requirements of Articles 123(2) and (3) EPC and 84 EPC 1973.

4.2 Inventive step (Article 52(1) EPC and 56 EPC 1973)

4.2.1 Closest prior art

In the decision under appeal, the opposition division considered document E2 to represent the closest prior art (see point 10.1 of the reasons of the impugned decision).

As stated in point 1 above, the invention to which the current request relates is based on the general concept of a cooling apparatus with a two-stage heat transfer mechanism, according to which heat is transferred away from a printed circuit board by a pulsating heat pipe (first stage) and then it is transferred away from the pulsating heat pipe by a loop heat pipe (second stage).

The board notes that none of the documents E1, E2 or E3 discloses a cooling apparatus with such a two-stage heat transfer mechanism.

Document E5, on the contrary, describes such an apparatus, which is built for the same purpose as the one of the claimed invention and has the most technical features in common (see following paragraphs). The board considers thus E5 to be a more suitable starting point for the skilled person, i.e. to represent the closest prior art.

E5 describes a thermal bus system for a cabinet housing high power, high thermal profile electronic components and systems (paragraph [0002]). The system comprises a first thermal assembly (e.g. a heat pipe) thermally coupled between a heat generating structure (electronic component as a heat source) located on a printed circuit card (board) and a first thermal interface surface that is spaced away from the heat generating structure. A second thermal energy transfer assembly (e.g. a loop heat pipe) includes a second thermal interface surface which is pressed against the first

thermal interface surface so as to allow the busing (transfer) of thermal energy from the first energy transfer assembly to the second thermal energy transfer assembly by heat transfer from the first thermal interface surface to the second thermal interface surface (paragraph [0016]).

In more details (see Figure 1), there is an electronic system (4) which comprises one or more printed wiring boards (5) assembled together within a shell or pack (or chassis) (11) that is sized for mounting within a rack housing (14) (paragraph [0041]). There is a first card-lever cooling assembly (16) - see also Figure 2 - comprising one or more thermal saddle heat sinks (22), each one of which is placed atop an active, heat electronic component to conductively receive heat during operation of the electronic system. The assembly comprises further one or more heat pipes (24) and a thermal connector (26). The evaporator of the heat pipe is placed on the top surface of the thermal saddle (22) (paragraph [0043]). The thermal connector (26) comprises a cold plate (40) which is placed within the shell card (11). Thermal energy is removed from the heat generating electronic components, through the thermal saddles (22) and transported to thermal connector (26) by heat pipes (24) (paragraph [0046]).

A rack-cooling assembly (20) comprises (see paragraph [0052]) a plurality of modular loop thermosyphons (80) (e.g. loop heat pipes). Each of those loop thermosyphons (80) comprises an evaporator (82), a condenser (84), a vapor conduit (86) and a condensate conduit (88) (see Figure 8). Evaporator (82) comprises a thermal transfer interface surface (90), an inlet opening (92) and an outlet opening (94). This thermal transfer interface surface (90) is arranged to receive

thermal energy from (i.e. is thermally coupled to) the first card-lever assembly (16) via thermal connector (26). As it can be seen in Figure 7, thermal transfer interface surface (90) is also placed within the card shell (11).

4.2.2 Differences and technical problem

Comparing the apparatus of claim 1 of Auxiliary Request 4 to the one in E5, a first difference is that in E5 there is no mention of a pulsating heat pipe (PHP). The first card-level cooling assembly (16) comprises a heat pipe that corresponds to what is described in the patent as conventional heat pipes (see paragraphs [0044] and [0045] in E5).

Moreover, the (pulsating) heat pipe of the claimed apparatus is positioned to either extend along and proximate to one of the major surfaces of the printed circuit board or be embedded within the the printed circuit board, with its opposed ends coupled to the chassis housing. In the apparatus of E5 the first heat pipe (card level cooling assembly 16) is directly connected to the individual heat sources (electronic components) positioned on the printed circuit cards (boards) through thermal saddle heat sinks 22 (see Figures 1 and 2 and paragraph [0043]).

As it can be seen in Figures 3, 5 and 9 of the patent, the electronic circuit boards (PCB 12) are placed within a chassis housing (13). In E5 the electronic circuit boards are placed within a shell (chassis) (11) which is then placed within a rack housing (14), as it can be seen in Figure 1. In the claimed apparatus, the condenser of the PHP is placed within a wall of the chassis housing (Figure 3). In E5 the condenser of the

heat pipe is placed at the thermal connector (26) which is placed within the shell card (11).

Summarising, the apparatus of claim 1 differs from the one of E5 by the following features:

- it comprises a pulsating heat pipe;
- which is positioned to either extend along and proximate to one of the major surfaces of the printed circuit board or be embedded within the printed circuit board, with its opposed ends coupled to the chassis housing;
- the printed circuit cards (boards) are positioned in a chassis housing;
- the condenser of the pulsating heat pipe is positioned within a wall of the chassis housing.

As a technical effect of these distinguishing features, the board sees a simpler structure of the cooling apparatus. The skilled person is, thus, faced with the technical problem to provide a simpler structure for the cooling apparatus of E5.

4.2.3 Solution and obviousness

The board is of the opinion that the skilled person will find no hint in E5 of how to simplify the construction of the cooling apparatus and will, thus, not arrive at the claimed apparatus in an obvious way.

The shell (11) in which the printed circuit cards in E5 are placed does not allow for the positioning of the condenser of the first heat pipe (card level cooling assembly 16) within its housing. Although pulsating heat pipes may have been generally known as such (see for example document E3), the construction of the

apparatus in E5 (with the heat pipe thermally connected to each individual component/heat source) does not allow for the use of a pulsating heat pipe in the first card level cooling assembly 16 without further, extensive modifications to its structure.

None of the other prior art documents presently available would provide any help to the skilled person, either, since none of them describes a cooling apparatus with a two-stage heat transfer mechanism and the need to couple thermally two heat pipes.

The board comes, therefore, to the conclusion that the subject-matter of claim 1 involves an inventive step within the meaning of Article 56 EPC 1973. The same applies to claim 5, which defines a method for cooling at least one printed circuit board using an apparatus essentially corresponding to the apparatus of claim 1.

5. Hence, the board is satisfied that, taking into consideration the amendments made by the proprietor of the European patent during the opposition appeal proceedings, the patent and the invention to which it relates meet the requirements of the EPC and the patent is to be maintained as amended on the basis of Auxiliary Request 4, according to Article 102(3)(a) EPC 1973.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The case is remitted to the department of first instance with the order to maintain the patent as

amended in the following version:

- Claims 1 to 7 according to auxiliary request 4 filed with the letter dated 6 May 2019;

- Description: Pages 2, 3, 6 and 7 filed at the oral proceedings dated 7 June 2019 and pages 4 and 5 of the patent specification;

- Drawings: Figures 1 to 11 of the patent specification.

The Registrar: The Chairman:

S. Sánchez Chiquero G. Eliasson

Decision electronically authenticated